Appendix C. Boundary Condition Types

Specific application details for many of the boundary condition types are included in Chapter 3. Boundary condition numbers have a superscripted symbol that indicates if they have been linearized for use with ILHS=26 or 27. Those that have been linearized have a +, approximately linearized have a *, and those that have not been linearized have a -.

Boundary condition types (IBTYP)

Type	*Description*
-1	Inviscid adiabatic wall for orphan points only
1^+	Inviscid adiabatic wall (pressure extrapolation)
2^*	Inviscid adiabatic wall (normal momentum equation)
3^+	Inviscid constant temperature wall (pressure extrapolation) (Wall temperature specified by BCPAR1 – degrees Rankine)
4^*	Inviscid constant temperature wall (normal momentum eqn) (Wall temperature specified by BCPAR1 – degrees Rankine)
5^+	Viscous adiabatic wall (pressure extrapolation)
6^*	Viscous adiabatic wall (normal momentum equation)
7^+	Viscous constant temperature wall (pressure extrapolation) (Wall temperature specified by BCPAR1 – degrees Rankine)
8^*	Viscous constant temperature wall (normal momentum eqn) (Wall temperature specified by BCPAR1 – degrees Rankine)
9^-	Viscous adiabatic wall with rotation about the positive *x*, *y*, or *z*-axis (Rotation rate specified by BCPAR1, axis specified by BCPAR2=1,2,3 for *x*,*y*,*z*, resp.)
10^+	Periodic condition (apply to either 1 or last plane)
11^-	Symmetry in X (apply to 1 and/or last separately). Requires a reflection plane.
12^-	Symmetry in Y (apply to 1 and/or last separately). Requires a reflection plane.
13^-	Symmetry in Z (apply to 1 and/or last separately). Requires a reflection plane.
14^*	Axis (J around) (Order of extrapolation given by BCPAR1)
15^*	Axis (K around) (Order of extrapolation given by BCPAR1)
16^*	Axis (L around) (Order of extrapolation given by BCPAR1)
17^+	Symmetry with no reflection plane
18^+	Periodic flow/nonperiodic grid (apply to either 1 or last plane)
21^+	2D condition in Y (3 planes supplied, ±1 in Y) (apply to first or last plane)
22^+	Axisymmetric condition in Y, rotate about X (3 planes supplied, $\pm 1^o$ rotation) (apply to first or last plane)
30^+	Outflow (pure extrapolation)
31^-	Characteristic condition based on Riemann invariants
32^-	Supersonic/subsonic inflow/outflow
33^+	Specified pressure outflow (Outflow pressure given by BCPAR1 = p/p_∞)
34^-	Specified mass flow through FOMOCO component (constant pressure) (Target mass flow specified by BCPAR1 = $\rho/\rho_\infty * u/u_\infty * A/A_{ref}$) (Update rate and relaxation specified by BCPAR2 as update.relaxation) (Component name from FOMOCO input specified by BCFILE; A_{ref} will also be taken from this file)
35^+	Outflow (1st-order extrapolation of pressure, velocity, and stagnation enthalpy)
36^-	Specified mass flow through FOMOCO component (variable pressure) (Specification same as BC#34)
37^-	Rotor far-field source/sink condition. Requires CTP and ASPCTR from NAMELIST

40^{+} Impose free stream
41^{+} Nozzle inflow (p_0, T_0 constant, mass flow extrapolated)
(BCPAR1 = $p_0/p_{0\infty}$, BCPAR2 = $T_0/T_{0\infty}$)
42^{+} Prescribed Q (read from file)
(BCPAR1 = starting iteration)
(BCPAR2 >0 use slow start)
(BCFILE = Name of file to read for Q)
OPEN(10,FILE=BCFILE,STATUS='OLD',FORM='UNFORMATTED')
READ(10) J1,K1,L1
READ(10)
READ(10) Q(JS:JE,KS:KE,LS:LE,1:NQ)
44^{-} Actuator disk (IDIR is flow direction)
(BCPAR1 = $\Delta p/p_\infty$)
45^{-} Prescribed Q (read from file)/inflow-outflow condition
(BCPAR1 = starting iteration)
(BCPAR2 >0 use slow start)
(BCFILE = Name of file to read for Q)
OPEN(10,FILE=BCFILE,STATUS='OLD',FORM='UNFORMATTED')
READ(10) J1,K1,L1
READ(10)
READ(10) Q(JS:JE,KS:KE,LS:LE,1:NQ)
47^{+} Characteristic outflow condition based on Riemann invariants with freestream imposed on incoming characteristics
48^{-} Simple jet mass flow condition
(BCPAR1 = $(\rho V)_{jet}/(\rho V)_\infty$)
49^{+} Default (no change)

51^{+} C-grid flow-through (J is C-direction)(specify one side)
52^{+} C-grid flow-through (K is C-direction)(specify one side)
53^{+} C-grid flow-through (L is C-direction)(specify one side)
54^{-} Fold-over cut flow-through (fold-over in J)
55^{-} Fold-over cut flow-through (fold-over in K)
56^{-} Fold-over cut flow-through (fold-over in L)
57^{*} C-grid at a wall (apply wall first) (J is C-direction)
58^{*} C-grid at a wall (apply wall first) (K is C-direction)
59^{*} C-grid at a wall (apply wall first) (L is C-direction)

61^{-} Blank out region (set IBLANK=0)

70^{-} Copy to (must be immediately followed by a "copy from")
71^{-} Copy from

82^{+} Slotted wind tunnel wall (modify wall pressure)
(BCPAR1 = R)
86^{+} Wind tunnel exit specified mass flow condition
(BCPAR1 = A_{exit}/A_{ref})

107^{-} Viscous wall with specified temperature (read from file)
TWALL in deg. R.
(BCFILE = PLOT3D function file)
OPEN(10,FILE=BCFILE,STATUS='OLD',FORM='UNFORMATTED')
READ(10) J1,K1,L1,NF(=1)
READ(10) TWALL(JS:JE,KS:KE,LS:LE)
108^{-} Viscous wall with specified bleed/suction (read from file)
MFR normalized by $\rho_\infty * V_{ref}$, positive into domain; TWALL in deg. R.

(BCPAR1 = TSWITCH: <0 always set T_{wall}; =0 set T_{wall} where MFR≥0; >0 never set T_{wall} (adiabatic wall))
(default TSWITCH=0 if TWALL is present, 1 if no TWALL)
(BCFILE = PLOT3D function file)
OPEN(10,FILE=BCFILE,STATUS='OLD',FORM='UNFORMATTED')
READ(10) J1,K1,L1,NF(=2)
READ(10) MFR(JS:JE,KS:KE,LS:LE),TWALL(JS:JE,KS:KE,LS:LE)
or
READ(10) J1,K1,L1,NF(=1)
READ(10) MFR(JS:JE,KS:KE,LS:LE)

141* Plug nozzle inflow (p_0, T_0 constant; density, velocity, and pressure extrapolated and averaged across face)
(BCPAR1 = $p_0/p_{0\infty}$, BCPAR2 = $T_0/T_{0\infty}$)

142- Time-varying velocity perturbation condition
(BCPAR1 = step to begin transient)
(BCFILE = file name for transient)
READ(20,*) XMIN,XMAX,XFREQ,XPHASE
VSCALE = 0.5*(XMAX+XMIN)+0.5*(XMAX-XMIN)*COS(2.*PI*(XFREQ*TIME+XPHASE))

143- Plug nozzle inflow, constant across FOMOCO component (p_0, T_0 constant; density, velocity, and pressure extrapolated and averaged across face)
(BCPAR1 = $p_0/p_{0\infty}$, BCPAR2 = $T_0/T_{0\infty}$, BCFILE = Component name from FOMOCO input)

145- Prop/rotor source term model
(BCFILE = rotor model namelist input file)

148- Time-varying simple jet mass flow condition
(BCPAR1 = $(\rho V)_{jet}/(\rho V)_\infty$)

151- Uniform inflow with specified direction

153- Time-varying uniform inflow through FOMOCO component
(BCPAR1 = starting step#, BCPAR2 = number of slow-start steps, BCFILE = throttle table)
READ(20,*) P0_RATIO,T0_RATIO
If multiple species: READ(20,*) SCINFLOW(1:NQC)
READ(20,*) FOMOCO_COMPONENT_NAME
READ(20,*) N_TABLE
DO I=1,N_TABLE
  READ(20,*) TIME,THRUST
ENDDO

201- Unsteady flow output option
(Output file name given by BCFILE; BCPAR1 = starting iteration, BCPAR2 = iteration increment)

601- Vortex generator vane source term model of Kenrick Waithe (NASA Langley)
(BCFILE = VG info file)
READ(20,*) C,SVG,ALPHA,FLOWDIR
(C is source constant (~10), SVG is VG surface area, ALPHA is vane angle (deg) relative to FLOWDIR, FLOWDIR is (roughly) coordinate direction of free-stream (+/-1,2,3 for J,K,L))